Climate resilience in the blood supply chain: safety and sustainability

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Background:

In Australia, intense and unpredictable extreme events and weather pose continuous threats (Figure 1), yet their effects on blood supply management remain largely unexplored.

Aim:

To examine the connections between climate change and blood safety and supply and the impact of COVID-19, bushfires, and floods on blood donation numbers in Australia.

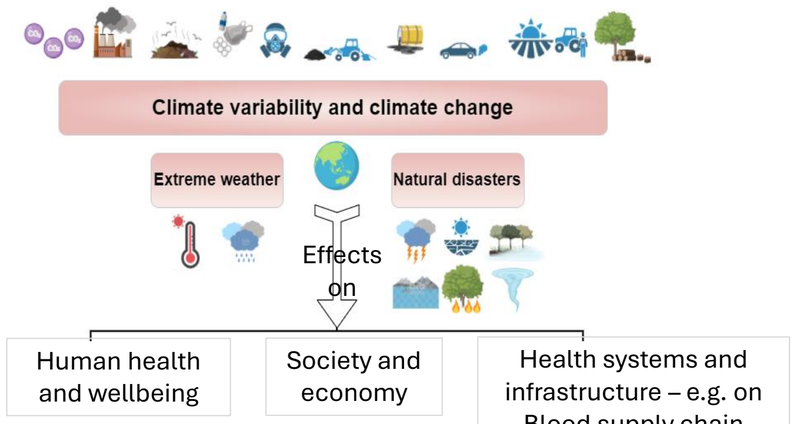

Figure 1: Threats from climate change

Methods:

Literature review

- Using PubMed, Embase, and Scopus with keywords related to "blood supply," "climate change," and "natural disasters",
- Focusing on the impact of climate change on blood donations, supply logistics included, excluding those not addressing logistics or supply chain aspects.

Datasets and source

- Weekly data on blood donation counts, cancellations, and staff availability (Australian Red Cross Lifeblood),
- COVID-19 pandemic (Australian Department of Health and Aged Care), bushfires and air quality (Government Open Data Portals), and rainfall (Bureau of Meteorology) – flood events data not available,
- Data range: 2019 to 2022 at national level and New South Wales (NSW) = state the most affected by floods and bushfires.

Descriptive analysis – correlation analysis – Negative Binomial regression models at national and NSW level

Results:

Literature review

- 11 potentially relevant papers and abstracts (Table 1).

Table 1: Annual distribution of studies on climate change impact on blood donation supply chain

Years	2009	2013	2016	2017	2021	2023	2024
Number of articles/abstracts	2	1	1	1	2	3	1

- Only two of these, original research articles[(1,2)] specifically modelled transfusion-transmitted infections under future climate scenarios, highlighting implications for blood safety and collection.

Descriptive analysis – time series visualisation

No clear patterns observed between blood donation numbers and other variables (Figure 2).

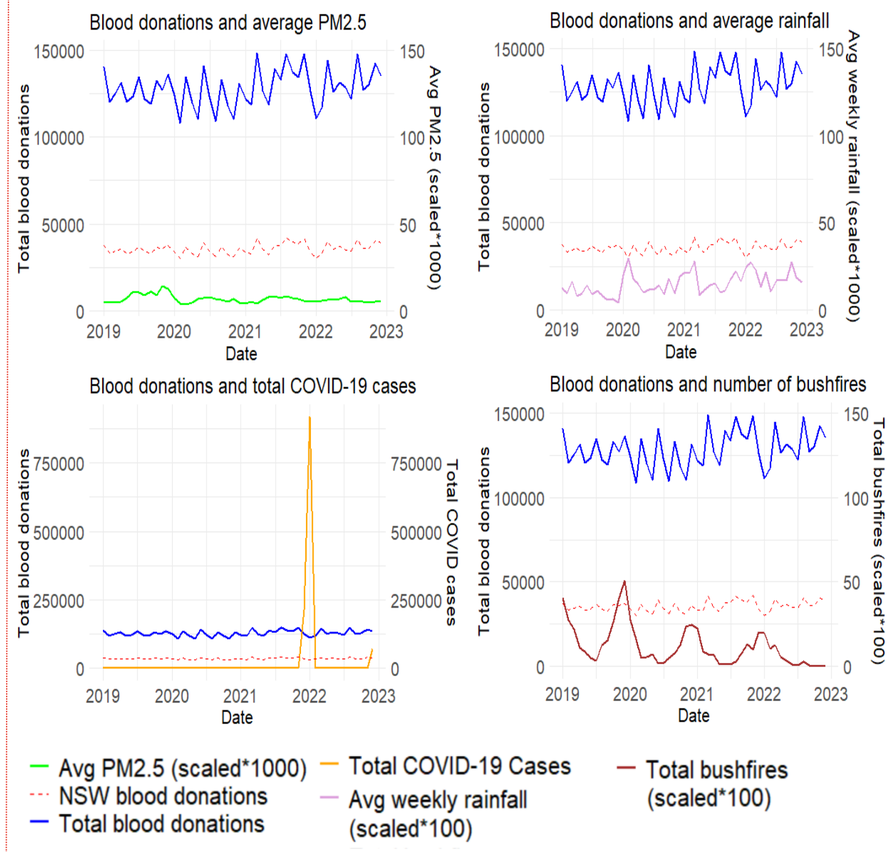

Figure 2: Time series of the number of blood donations along rainfall, bushfires, COVID-19 cases, air quality from Jan 2019 to June 2022

Correlation analysis – national level

No strong correlations between blood donation numbers, number of COVID-19 cases, number of bushfires, average mean particle matter PM2.5, and average rainfall (Figure 3).

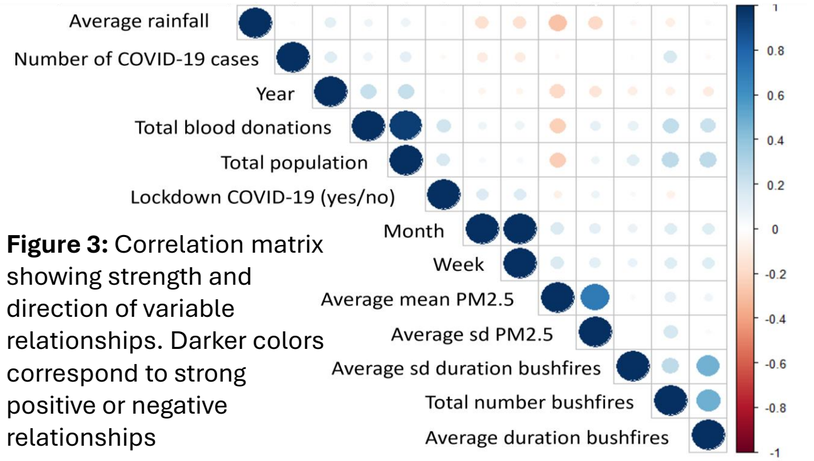

Figure 3: Correlation matrix showing strength and direction of variable relationships. Darker colors correspond to strong positive or negative relationships

Modelling at national level

- For an increase of 1 in PM2.5, blood donations decrease by approximately 2.74% (p-value < 0.001).
- Rainfall, COVID-19 cases, bushfires not associated with number of blood donations.

Modelling focus on NSW

- If the number of bushfires increases by 1, blood donations would decrease by approximately 5.3% (p-value < 0.01).
- Rainfall, COVID-19 cases, air quality not associated with blood donations.

Discussion and conclusion:

- **Limited understanding** of climate impacts on each blood supply chain stage
- **National and state-level variations**: at national level, air pollution had a small negative impact on number of blood donations.
  In NSW, number of bushfires associated with decreased number of blood donations.

Future focus:

Need **more granular analysis**: focus on more localized analyses to better understand regional variations and improve resilience in the blood supply chain.

1. Bambrick HJ, et al. *Global Health Action* 2009; **2**(1).
2. Semenza JC et al. *Environmental Health: A Global Access Science Source* 2016; **15**.

Australian governments fund Australian Red Cross Lifeblood to provide blood, blood products and services to the Australian community.